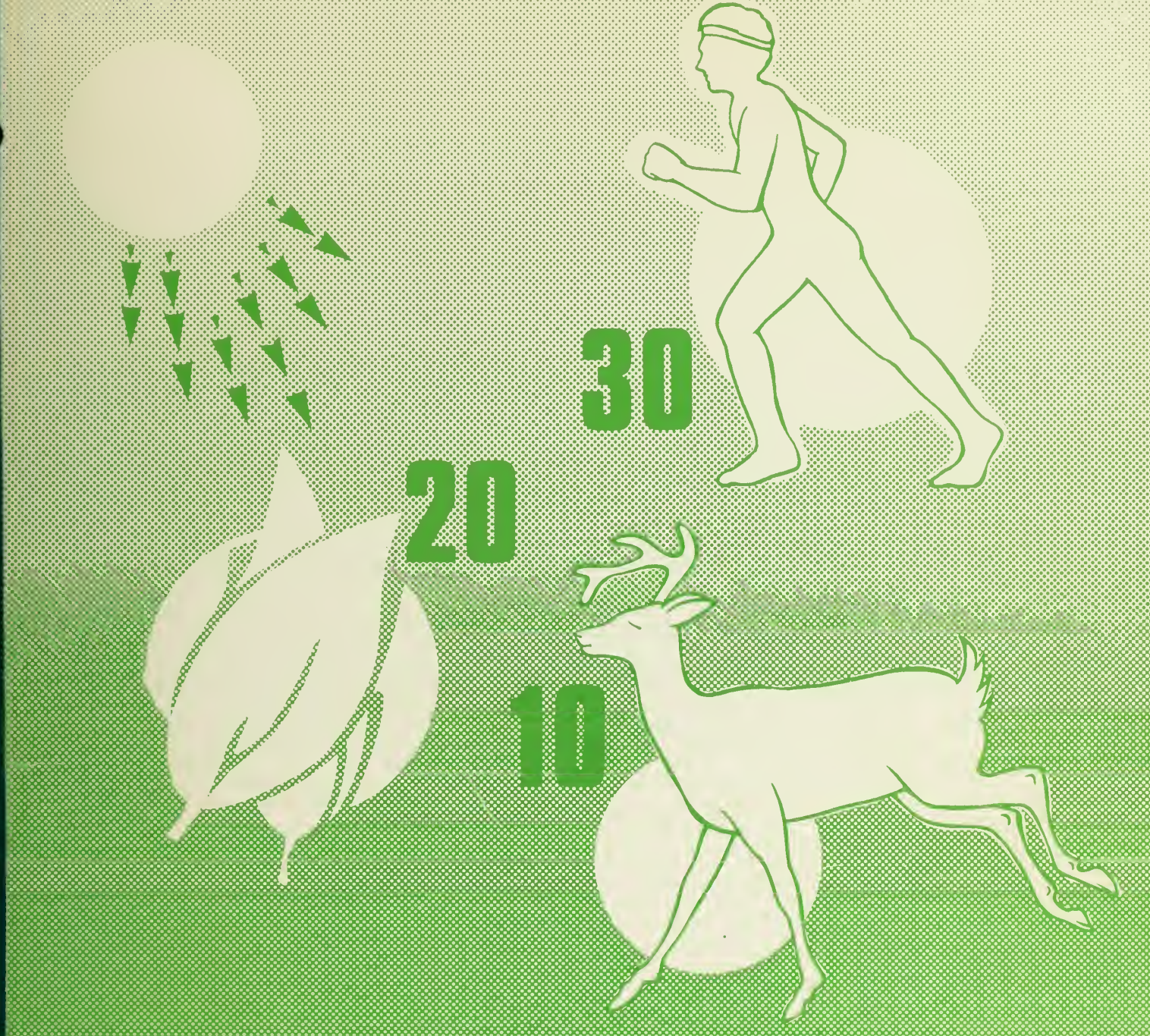




BIOLOGY 10-20-30

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IMPORTANT NOTE

The program of studies concepts statements for Biology 10 and 20 contained in this guide are mandatory, effective September 1983. Revisions to the Biology 30 course will be piloted during the 1983-84 school term and are scheduled for mandatory implementation, September 1984. A proposed concept outline for Biology 30 is included in this guide for information and pilot purposes only. Schools not involved in the Biology 30 provincial pilot are required to follow the 1975 Biology program of studies for the 1983-84 term.

Content weightings, objectives and other statements describing the process skills, attitudes, psychomotor components of the 1983 revision are, in fact, a re-statement of the 1975 program of studies, phrased in more specific terms.

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NOTE: This publication is a service document. The advice and direction offered is suggestive except where it duplicates or paraphrases the contents of the Program of Studies. In these instances, the content is colour coded in the same distinctive manner as this notice so that the reader may readily identify all prescriptive statements or segments of the document.



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PHILOSOPHY

The biological sciences program identifies the natural laws of science and places these fundamental concepts in a socially relevant and personally meaningful context for students. The study of biology can no longer be restricted just to factual information; the open-endedness of science and the tentativeness of scientific knowledge necessitates a broader understanding of basic concepts and the development of theories and principles.

The goals of biology programs in the 1960s emphasized the knowledge and skills important for understanding the structure of biology as a scientific discipline. Rapidly advancing research brought greater comprehension and more clarification to the biological sciences and, as in the 1970's, the goals shifted slightly toward ecological problems and the role of science and technology in society. Environmental issues were also added to the biology program. However, the primary goal of biology remained knowledge, with environmental issues being presented within that extreme detail in an ever expanding curriculum. Excessive detail can cloud general principles that provide a solid foundation to understanding the natural laws of science. An important challenge to teachers will be to sort out the "relevant" from the "not so relevant" information and to present this information in a manner consistent with their students' maturity, interest and need.

The traditional approach to biology has been to reveal only the knowledge that scientists have accumulated, as though science were a closed book. Rarely has instruction been devoted to what is not known, what might be the future direction for research on a problem, or what new technologies are likely to be spawned from research information at hand. Nor do most students leave science courses with the notion that the world they are going into will be different from the one they have been studying.

A biology curriculum for the 1980s must use knowledge to develop fundamental concepts in a socially relevant and personally meaningful context for students. A progressive biology program must address itself to a student's personal needs through content such as proper nutrition, the effects of alcohol and drugs, and career awareness. The 1980s demand that a recognition of environmental concepts, societal issues and world problems be incorporated into the biology program. Analyzing and responding to these concerns necessitates intellectual techniques and information gathered from the natural and social sciences. This requires that the presentation of biological knowledge not be isolated from other disciplines such as economics, politics and sociology.

A biology program for the 1980's and 1990's must address itself to the fact that most students will not become biologists; thus, the primary goal will not be the imparting of knowledge. Rather, the student should come away with an understanding of the principles of modern biological thought, an awareness of the importance that sound biological knowledge may have to solving individual problems and those of society as a whole. It follows then that awareness of and interest in biology is a lifelong concern, if not a vocation.



RATIONALE

The biological sciences program identifies the natural laws of science and places these fundamental concepts in a socially relevant and personally meaningful context for students. The biology program is designed to provide students with an appreciation of the development of biological knowledge. Concepts and theories are based on facts and are meaningless without them, but the converse is also true. Facts, as isolated fragments of information, are meaningless and are not useful to the scientist or the science student. They must be related to concepts and theories if they are to be relevant, and must be presented as a means to an end, as in problem solving.

The curriculum has been designed in a manner that will provide every student in the province with a common core component. An elective component allows the teacher to identify regional environmental issues, meet specific individual needs or foster an appreciation and enthusiasm for subject matter not designated by the core component.

Descriptive statements, time allocations and clarifications throughout the curriculum guide have been organized in a manner that will provide direction and guidance with regard to the information provided and the depth of detail expected. The textbook is not designed to determine content, provide order, give all of the examples or provide the applications of the content. Much of the criticism levelled at textbooks arises from expectations that far exceed the intent of any learning resource. Teachers who believe that a textbook provides curriculum often lament, "If only the right one could be found." It should be noted that the specificity prescribed by the descriptive statements encourages teachers, more than ever, to become involved with curriculum by developing examples and providing applications of that content as it relates to students, in a current and regionally significant manner.

Biology 10

The structure and discussion of cellular function has been limited to those structures as seen through the light microscope. A discussion of cytoplasmic organelles that cannot be seen in the laboratory adds excessive detail and tends to be isolated from laboratory experience. The mitochondria, as organelles, are better discussed when associated with the processes of cellular respiration. Any discussion of ribosomes should be placed in the context of protein synthesis, where terms like amino acids, nucleotides and nitrogen bases can be dealt with in an organized and unified manner.

The microscope and development of cell theory provides an historical perspective to the interrelationships between biology, technology and their influences on society.

Biologists do not agree on a universally accepted classification system. The intent of the unit on classification is to provide students with the rationale for grouping organisms into taxonomic levels without focusing upon criteria for three, four or five kingdom systems. Any discussions of kingdoms should be consistent with the textbook used in the course.

The survey of living organisms is intended to provide students entering the biology program with an introduction to the similarities and differences exemplified by various life forms. Selected representatives of lower forms, plants and animals, ensure that no group of organisms can be omitted in favor of an extensive and exhaustive study of another group. Traditionally, a teacher with training in zoology, botany or microbiology has presented a core component that has reflected his or her professional bias, thereby creating programs and presentations that varied greatly throughout the province, and often within school systems or even individual schools. The descriptive statements, suggested time allocations and clarification statements should provide some commonality of core, while the elective component encourages the teacher to become involved with curriculum development in a manner that meets the needs of his or her students.

Biology 20

The ecology unit in the biology program should provide an appreciation of the position of life forms and complex interactions of these organisms within the ecosystem. The factual information provided in this section can provide a foundation to a problem solving and decision making approach to ecology.

Because of its significance, a general discussion of photosynthesis has been introduced at the Biology 20 level. This brings the process of food production into perspective as the base of the food chain and makes the information a cornerstone to the evaluation of environmental problems. All too often ecology has been approached from an animal oriented avenue, thereby creating a limited view of our biosphere and the interactions that occur within it. The concepts of electron transfer, high energy bonds and enzyme reactions should not be discussed at this level since the students have yet to acquire an adequate background in biochemistry; however, many investigative studies can be pursued at this level. For example, investigations such as how light intensity affects the rate of photosynthesis, the function of chlorophyll in photosynthesis, the effects of light upon starch production in a leaf, and techniques for separating pigments in leaves, can be undertaken.

The influences and impact that man has on the ecosystem has been placed in context with specific studies about the environment. After establishing the principles of the water cycle, for example, a discussion of acid rain has been introduced as a model of man's influences. Because the problems presented by acid rain offer no simple solutions, students are

encouraged to become involved with decision making processes and the evaluation of technical data. By assimilating the principles of the hydrologic cycle and the problems presented by acid rain, the program allows the student to view the factual material from a relevant and meaningful perspective.

A presentation of the knowledge derived from genetic principles, the structure of DNA and cell division lends itself to the extension of the factual information to the development of scientific theories which can be exemplified by the theories of evolution.



Biology 30 (Pilot)

The Biology 30 program introduces cellular function, biochemistry and physiology. Because of the nature of the materials and the depth of presentation, the concepts are introduced using human systems. Although the focus is on human physiology, it should be noted that many of the concepts developed within the program can readily be adapted to other organisms. The study of

cytoplasmic organelles, principles of cellular respiration, operation of enzyme systems, the physical processes of a cell and controls of hormone levels provide us with just a few examples. Because the Biology 30 curriculum concentrates on human physiology, it is directed toward the individual needs of the student. Any repetition of these general principles which have been identified in the human system, be they incorporated through the study of plant physiology, invertebrate physiology or the physiology of a lower form chordate, is not included in the core, but may be handled through electives.

The curriculum encourages an integrated approach be adopted to the study of human systems. The fundamental principles of kidney function, for example, may be associated with a functioning cardiovascular system, hormone system, digestion and liver function. By approaching the human body from an application and homeostatic adaptation strategy, the systems can readily be related to each other. The alternate approach, which is derived from a primary knowledge based goal, deals with systems as isolated units working independently and stresses anatomy, terminology and rote memory.

To be consistent with the goals of the program, an exhaustive or extensive study of biochemistry would not be attempted. The depth of treatment of this topic should be based upon the fact that many students enter the Biology 30 program without any chemistry background. A detailed approach to difficult topics such as cellular respiration also tends to cloud the understanding of fundamental ideas such as the basic differences between aerobic and anaerobic respiration, the idea that oxidation of an organic compound releases energy which can be stored by cells, and the uses of the stored energy. Memorizing the names or chemical structures of intermediary metabolites for oxidative phosphorylation or the Krebs cycle tends to confuse students rather than promote understanding and generate interest in the topic.

The curriculum is designed to initiate a movement away from a didactic dissemination of factual information towards more relevant utilizations of knowledge. The integration of open-ended questions, environmental problems and societal issues, where appropriate in the core materials and/or the elective component, should better enable our students to meet the challenges presented by the 1980s.

LEARNING RESOURCES FOR BIOLOGY 10 AND 20

LEARNING RESOURCE APPROVALS

In terms of provincial policy, learning resources are those print, nonprint and electronic courseware materials used by teachers or students to facilitate teaching and learning.

PRESCRIBED LEARNING RESOURCES are those learning resources approved by the Minister as being most appropriate for meeting the majority of goals and objectives for courses, or substantial components of courses, outlined in provincial Programs of Study.

RECOMMENDED LEARNING RESOURCES are those learning resources approved by Alberta Education because they complement Prescribed Learning Resources by making an important contribution to the attainment of one or more of the major goals of courses outlined in the provincial Programs of Study.

SUPPLEMENTARY LEARNING RESOURCES are those additional learning resources identified by teachers, school boards or Alberta Education to support courses outlined in the provincial Programs of Study by reinforcing or enriching the learning experience.

Prescribed:

Biology - Silver Burdett (General Learning Corporation - Canada), 1983

Biology: Living Systems - Merrill (Bell and Howell - Canada), 1983

Laboratory Biology - Investigating Living Systems
- Merrill (Bell and Howell - Canada), 1983

Recommended:

Modern Biology - Holt Rinehart and Winston, 1981

Two textbooks and one laboratory manual have been approved for pre-scribed listing for Biology 10-20. It is the intent to have the same textbook for both Biology 10 and 20. Both textbooks contain more material than is necessary to cover the minimum core component as outlined in the program of studies. The laboratory manual approved for prescribed status is self-contained. That is, it may be used with either textbook used. A third textbook is listed but is on the recommended list. This book provides good material for enrichment, elective work and further study and is not intended for use as a student textbook.

PROGRAM OF STUDIES

PROGRAM OF STUDIES

Curriculum Specifications: Content Emphasis

The biology program is based on four major components: process skills, psychomotor skills, attitudes and concepts (subject matter). The percentage emphasis of each component for instruction in Biology 10, 20 and 30 is listed in the table below. Even though each component is listed separately, instruction should integrate process skills, psychomotor skills and attitudes with the development of concepts. Not all these skills nor attitudes have equal emphasis at each course level. Hence development of these components should take place as the concepts are presented.

Course Content	Biology 10	Biology 20	Biology 30
Process Skills	30	30	20
Psychomotor Skills	10	10	5
Attitudes	10	10	15
Concepts (Subject Matter)	50	50	60

GOALS AND OBJECTIVES

General Objectives of Science Education Grades One Through Twelve

1. To develop the ability to inquire and investigate through the use of science process skills.
2. To promote assimilation of scientific knowledge.
3. To develop attitudes, interests, values, appreciations and adjustments similar to those ideally exhibited by scientists at work.
4. To develop an awareness and understanding of the environment with positive attitudes and behaviors towards its use.
5. To develop a critical understanding of those current social problems which have a significant scientific component in terms of their causes and/or their solutions.
6. To promote awareness of the humanistic implications of science.
7. To promote an understanding of the role that science has in the development of societies and the impact of society upon science.
8. To contribute to the development of vocational knowledge and skill.



General Goals of Biology 10, 20 and 30

1. To develop an understanding of the interrelationships of biology, technology and their influence on society.
2. To develop those attitudes, psychomotor and process skills which are associated with scientific inquiry.
3. To develop an interest in biology as a natural science.
4. To develop an awareness of the delicate balance of nature and the appreciation that the survival of all life forms depends upon this balance.
5. To encourage further interest in biological phenomena through the use of electives.
6. To provide an historical perspective to developments in the biological sciences.
7. To prepare students to make responsible decisions regarding science related social issues.
8. To develop an appreciation of how biologists carry out their work.
9. To make students aware of possible careers in the field of the biological sciences.

Objectives of the Biology 10 Program

1. To identify some of the characteristics that distinguish living things from non-living things.
2. To develop an understanding of the development of the cell theory and its application.
3. To understand how organisms can be classified into various levels.
4. To initiate an understanding of the differences and similarities that exist among organisms.
5. To develop effective techniques in the use of microscopes.
6. To develop effective dissecting techniques.



Objectives of the Biology 20 Program

1. To develop understandings of the interactions and interrelationships between biotic and abiotic factors within communities, ecosystems and biomes.
2. To understand the principles of genetics.
3. To recognize some of the reasons why there is a great diversity among organisms.
4. To examine man's impact on the biosphere.

Objectives of the Biology 30 Program

1. To examine selected cell structures and functions.
2. To introduce a chemical basis for life.
3. To examine the following human processes:
 - a) Alimentation and nutritional needs
 - b) Circulation of body fluids
 - c) Breathing and gas exchange
 - d) Cellular respiration
 - e) Movement and support
 - f) Regulation of body fluids
 - g) Nervous and hormonal control systems
 - h) Reproduction

Process Skills

Scientific investigation or inquiry requires the collection and processing of information from the environment. The activities which scientists exhibit while researching or problem solving are referred to as process skills and are fundamental to the scientific method.

Process skills are incorporated into the biology program through classroom work and, in particular, the laboratory experience. Activities such as observing, hypothesizing, predicting, measuring and interpreting data are stressed at all levels. The observation and recording of data is highly significant when examining cell structure and representative organisms in the Biology 10 program. The study of succession in Biology 20 involves, in particular, the prediction of changes in ecosystems over time. The investigation of biochemical reactions in Biology 30 requires an understanding of the control and manipulation of variables.



The table below lists process skills covered in the biology program. Each skill is given a relative importance rating based on the specific course being taught. The letter "A" is of highest importance, "B" is medium and "C" is the lowest. Although the process skills are stressed at all grade levels, course content may determine which particular skills should be emphasized.

Process Skill	Grade Level		
	Biology 10	Biology 20	Biology 30
Identifying problems	B	A	A
Controlling variables	C	A	A
Hypothesizing	B	A	A
Predicting	B	A	A
Design of methods for data collection	C	B	B
Observing	A	A	A
Measuring	B	B	A
Processing of data	A	A	A
Classifying	A	B	C
Interpreting data	A	A	A
Inferring	B	A	A
Defining operationally	A	A	A
Formulating models	B	A	A
Seeking further evidence	B	B	B
Applying discovered knowledge	B	A	A

Psychomotor Skills

Psychomotor skills can be identified as those skills which involve an integration between muscular movement and intellect. A progressive development of many of these skills throughout the high school biology program is needed to provide a meaningful scientific experience.

The psychomotor skills can be developed and refined as the student progresses in the biology program. Safety must be a primary concern while the development of these skills occurs. Because many of the skills are progressive and repeated at the three levels of biology, no attempt was made to assign the skills to any one level.

Because of the flexibility provided by electives and the special resources of individual schools, the examples provided for the different psychomotor skills is not to be interpreted as a prescriptive list but merely as representative of the psychomotor skills they define.

The students should have the ability to:

1. Manipulate equipment, for example:
 - a) Microscope
 - b) Bunsen burner
 - c) Microcomputers
 - d) Centrifuge
 - e) Water baths
 - f) Hot plates
 - g) Balance
 - h) Stethoscopes and sphygmomanometers
2. Use tools:
 - a) To develop proficiency in the use of various tools and instruments
 - b) Use of dissecting instruments
 - c) Use of common laboratory tools (beakers, tongs, graduated cylinders, etc.)
 - d) Use of mortar and pestle

3. Carry out accepted procedures:
 - a) Preparation of wet and dry mount slides
 - b) Develop techniques for the separation of pigments
 - c) Staining techniques
 - d) Collecting and preserving techniques
 - e) Dissecting procedures
 - f) Biochemical analysis techniques
 - g) Focusing microscopes
4. Develop safe practices and procedures:
 - a) Safe use of chemicals in the laboratory
 - b) Antiseptic techniques for microbiology
 - c) Proper handling of supplies and equipment
 - d) Proper handling of living specimens



Attitudinal Objectives

General

1. To promote an appreciation of the interrelationships between biology, technology and their influence on society
2. To develop an interest in biology as a natural science
3. To develop an interest and appreciation of the attitudes demonstrated by scientists in their work
4. To develop a sense of responsibility in decision making concerning science related social issues
5. To develop an appreciation of science as an important vocational and intellectual pursuit
6. To develop an appreciation of the historical development of modern science

Biology 10

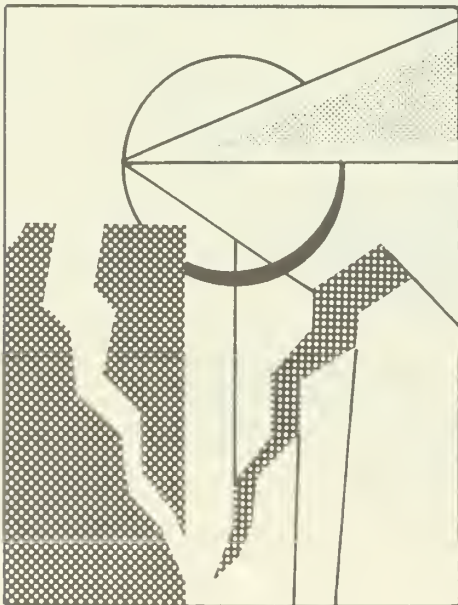
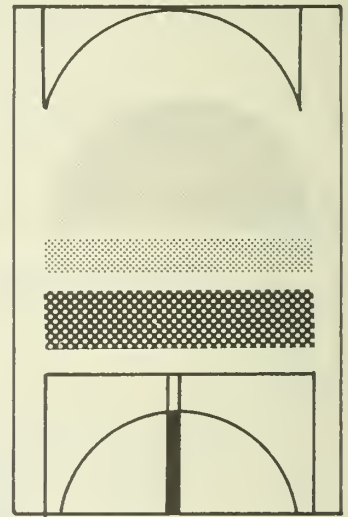
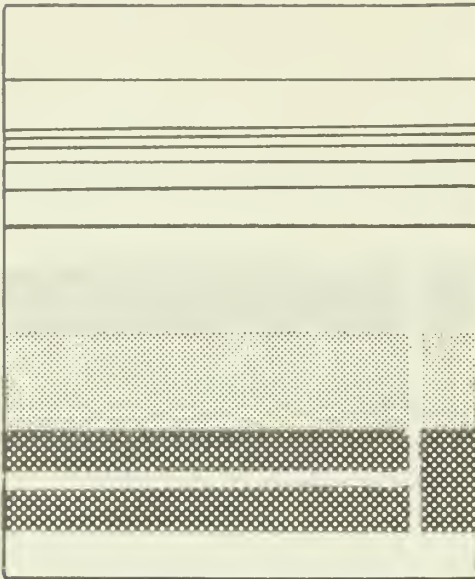
1. To develop an appreciation of the diversity among living things

Biology 20

1. To develop an appreciation of the role man plays in his environment and of his dependence upon that environment
2. To develop an appreciation of the interdependence of living organisms within their environment
3. To develop positive attitudes and behaviors towards the use of the environment

Biology 30

1. To develop an appreciation of the interdependence of human organ systems and their functioning in a homeostatic relationship



Concept Description Statements

The concept statements which follow for Biology 10 and 20 are mandatory, effective September 1983. The statements for Biology 30 are tentative and subject to review through piloting during the 1983-84 school term. Schools not involved in the Biology 30 provincial pilot are required to follow the 1975 program of studies statements.

The order of topics, and the concepts therein, are not prescriptive. The subject matter reflected in the concept statements should be developed and presented in a sequence that is appropriate and meaningful to the teacher and students. Comments concerning the depth and coverage of the concepts are provided where necessary for clarification purposes.

Social issues and environmental concerns should extend and be related to the core concept of the program. Including pertinent and current issues at the time that key concepts are being discussed provides meaning and application to the subject matter. Because social and environmental issues are constantly changing, their presentation should be in keeping with student interest and currency of the issue, environmentally and/or socially.



Biology 10

COMMENTS

I. Living things are composed of cells. (12 percent)	A. The work by Leeuwenhoek and Hooke resulted in the discovery of microscopic life which led to the development of the cell theory. B. Some cell structures can be viewed through a regular light microscope.	**The time emphasis here allows one to develop the historical dimension of the cell theory and the microscope and to carry out investigations teaching students how to use a microscope proficiently.
NOT: These time percentages are based on the 30 percent core component.	1. Eukaryotic cells are surrounded by a membrane enclosing cytoplasm and a nucleus. 2. Plant type cells usually include a cell wall, chloroplasts and often enlarged vacuoles.	**Only those cellular organelles that can be seen using a light microscope should be introduced at this time. Discussions of additional organelles should occur in context with concepts discussed, e.g., ribosomes with protein synthesis.
II. Taxonomy is the science of classifying organisms. (8 percent)	3. Plant and animal cells display unique and distinguishing characteristics. C. Multicellular organisms illustrate such levels of organization as tissues, organs and systems. A. Organisms are grouped on the basis of morphology. B. Organisms may also be grouped on the basis of other criteria such as degree of complexity, habitat or nutritional requirements. C. Linnaeus developed a system of binomial nomenclature. D. Difficulties have arisen in the development of a universally acceptable classification system. E. Dichotomous keys are a useful tool in classifying organisms.	
III. Viruses are sub-cellular structures. (3 percent)	A. Viruses have characteristics of both the living and the nonliving. B. Viruses reproduce within a host cell. C. Some diseases are associated with viruses.	**DNA or RNA replication (molecular structure) is not advised for this section.
IV. Life forms may exist at the unicellular and the multicellular levels of organization. (6 percent--bacteria)	A. Bacteria are considered the most primitive of known life forms. 1. Bacteria are typical of prokaryotic cells. 2. Bacteria have specific growth requirements. 3. Bacteria are of importance to other organisms. 4. Some diseases are associated with bacteria.	

(6 percent--
unicellular/colonial)

B. Many eukaryotic cells are unicellular or colonial.*

1. Paramecium is a representative protozoan.
2. Spirogyra exhibit the characteristics of colonial algae.

(5 percent--fungi)

C. Fungi have many unique characteristics.

1. Bread mold exhibits structural and functional characteristics of fungi.
2. Fungi are both harmful and beneficial.

(16 percent--plants)

D. Most plants are photosynthetic, multicellular organisms.

1. Mosses are successful plants lacking conductive tissue.
 - a) They occupy a variety of habitats.
 - b) They are economically important and significant to the functioning of a biotic community.

2. Ferns are nonseed plants which have conductive tissue.

3. Gymnosperms are nonflowering seed plants.**

- a) They display unique characteristics such as needles, naked seeds and cones.

b) They are of significant economic importance.

4. Angiosperms are flowering, seed-producing plants.

- a) their characteristics exemplify the most advanced plant form.

b) Vegetative parts--roots, stems and leaves have specific functions.*

*Emphasis should be on the structural rather than the genetic reproduction. This applies to all representative organisms.

**Identifying, diagramming or memorizing of internal anatomy is not mandatory to the understanding of plant function.

- c) Monocots differ from dicots in leaf venation, stem and root branching patterns, seed structure, and the number of flowering parts.
- d) The flower contains the reproductive organs of the plant.
- e) Seed and fruit production result from pollination and successful fertilization.***

***An indepth study of the mechanics of fertilization is not required.

E. Animals are multicellular organisms which demonstrate a phylogenetic progression towards a greater developmental complexity.

(12 percent--
invertebrates)

1. Porifera and coelenterata have two cell layers.
 - a) They demonstrate cell specialization.
 - b) Hydra is a primitive coelenterate possessing tissue and nematocysts.
2. Worms have three cell layers and primitive organ systems.
 - a) The tapeworm demonstrates adaptations to a parasitic life-style.
 - b) Lumbricus (the earthworm) provides a representation for an in-depth study of organ systems.
3. Mollusks and echinoderms are both harmful and beneficial to other organisms.
4. Arthropods are the largest group of animals.

- a) They share common characteristics.
- b) The crayfish provides representation for an in-depth study of more complex organ systems.
- c) The success of spiders and insects can be measured by their diversity and adaptations.

(12 percent--
chordates)

5. Chordates represent the most complex animal group.***
 - a) Chordates possess a notochord, gill pouches and a dorsal nerve cord.
 - b) Fish are a major group of primitive chordates.

***The general characteristics of each class illustrate progressive complexity in the development of organ systems.

- c) Amphibians have characteristics of both aquatic and terrestrial chordates. The frog provides representation of an in-depth study of chordate organ systems.
- d) Reptiles display characteristics of the first true terrestrial chordates.
- e) Birds display characteristics that adapt them for flight.
- f) Characteristics of mammals display the highest level of complexity.



Biology 20

1. Ecology is the study of the interrelationships between organisms and their environment.

(40 percent)

(20 percent--
interrelationships)

A. Many factors are involved in ecological interrelationships.

1. Biotic factors involve the living world.
2. Abiotic factors involve the nonliving world.
3. Biotic factors and abiotic factors interact.

a) Photosynthesis provides both energy and organic materials to the biotic world.*

- (1) Chlorophyll and accessory pigments absorb light energy.
- (2) Light energy is converted into chemical energy.
- (3) Chemical energy may be utilized in the synthesis of organic compounds.

b) The flow of matter through the ecosystem is cyclical and may be affected by man's activities.

- (1) Carbon-oxygen cycle and the greenhouse effect
- (2) Nitrogen cycle and the importance of soil bacteria
- (3) Water cycle and acid rain

c) Energy transfer through the biotic world is noncyclical.

d) Food chains, pyramids and webs map the flow of energy through the biotic world.

e) The introduction of herbicides and pesticides into an ecosystem have serious effects on food webs.

*Biochemical detail (oxidation-reduction, electron transfer and specific enzymes) are not required at this level. The intent is to establish food production as the basis of the food chain rather than cover a detailed study of the biochemical processes. These three statements should dictate depth of instruction. Laboratory investigations should be emphasized (see rationale, Biology 20, for examples).

(6 percent--populations)

B. Populations are composed of many individuals of the same species.

1. Populations are defined in terms of space, time and kind.
2. Populations are characterized by exponential growth patterns.
3. Limiting factors control population density.
4. Humans exemplify an overpopulation problem within a closed community.

(14 percent--
communities/biomes)

C. The biosphere is composed of communities, ecosystems and biomes.

1. The ecosystem is the fundamental unit of the biosphere.
 - a) Succession occurs when biotic communities change over time towards a climax community.
 - b) Organisms occupy a specific niche within a community.
 - c) Many habitats exist within a community.
2. Nutritional relationships exist within a community.
 - a) Symbiosis involves interaction between organisms.
 - (i) commensalism (ii) Mutualism (iii) parasitism
 - b) Predator-prey relationships exist in the biosphere.
 - c) Competition occurs within and between species.
 - d) Saprophytes and decomposers aid in the decomposition of organic material.
3. The biosphere contains fresh water ecosystems.
 - a) Changes in running and standing water ecosystems are dependent on physical factors *
 - b) Humans are the major contributor to the pollution of fresh water
4. Terrestrial ecosystems are studied in terms of biomes.

*Discussion should emphasize how physical factors affect change, rather than a detailed survey of the impact of all physical factors.

a) Canadian biomes are influenced by climate.*

*An overview of Canadian biomes only.

b) Major biomes exist in Alberta.

11. Genetics is the study

of the transmission
of characteristics
from one generation
to the next.

(40 percent)

(8 percent--
chromosomes/mitosis/
meiosis)

(2 percent--principles
of heredity--Mendel)
(18 percent--principles
of heredity--today)

(5 percent--DNA--
genetic code)

A. Chromosomes carry the hereditary material.

1. Mitosis is a process of nuclear replication during asexual reproduction.*

**Students should not be expected to memorize the details of events in individual phases of mitosis and meiosis, but merely be familiar with the overall sequences during the processes of nuclear replication and nuclear reduction.

2. Meiosis is a process of gamete formation necessary for sexual reproduction.

a) Diploid chromosome number is reduced to haploid chromosome number.

b) Cytoplasmic division differs between egg and sperm formation.

c) Abnormal meiotic division may occur.

B. Basic principles of heredity were established by Gregor Mendel.

C. Principles of heredity are based upon predictable results:**

***Students should be expected to solve simple problems involving these concepts.

1. monohybrid and dihybrid crosses

2. codominance and incomplete dominance

3. multiple alleles

4. sex linkage

D. DNA is the carrier of the genetic code.***

****It is not necessary to give specific triplet codes, RNA molecules or protein structures to develop these concepts.

1. Each DNA molecule is unique because of its sequence of nitrogen base pairs.

2. DNA is capable of replication.

3. Each protein is unique due to the sequence of amino acids it contains.

4. Specific proteins are synthesized according to sequence of nitrogen base pairs in the DNA molecule.

5. Cells and organisms exhibit traits due to their specific proteins.

6. Mutations arise from variations in the DNA or RNA molecules.

(7 percent--evolution)

- E. Hereditary changes affect the characteristics of organisms in a population.
1. Early biologists such as Lamarck and Darwin attempted to explain changes in characteristics in populations.
 2. Environmental factors influence gene expression.
 3. Several factors influence speciation.



Biology 30 (Pilot)

NOTE: The following concept statements for Biology 30 are for pilot purposes only and are not mandatory for the 1983-84 school term. They are provided for information purposes to indicate the proposed content of the Biology 30 based on the revisions to Biology 10 and 20. The 1975 program of studies for Biology 30 must be followed for those schools not involved in the provincial pilot.

1. Cellular processes are fundamental to life.
(16 percent)
 - A. Cells exhibit complex structure and function.
 1. Membranes
 2. Cytoplasm and nucleoplasm
 3. Organelles
 - B. Living organisms carry out chemical activities.
 1. Chemical bonding allows basic elements to form life supporting molecules.
 2. Oxidation-reduction processes are required for cellular activities.
 3. Basic organic and inorganic substances provide requirements for cell maintenance and growth.
 - a) Identify the importance of carbohydrates, proteins, lipids, nucleic acids, vitamins, minerals and water.
 - b) Identify the general structural and functional differences between carbohydrates, lipids and proteins.
 - C. Cell metabolism involves both anabolic and catabolic reactions.
 4. Cell metabolism involves both anabolic and catabolic reactions.
 5. Enzyme action regulates cell metabolism.
 6. Competitive inhibitors interfere with enzyme activity.
 - C. Substances necessary for life are transported by physical and chemical processes.
 1. Diffusion and osmosis
 2. Active transport
 3. Endocytosis and exocytosis

- II. Humans must take in and prepare the required nutrients for absorption.
(8 percent)
 - A. Digestion includes the physical and chemical breakdown of ingested macromolecules preparing them for absorption.
 1. Oral
 2. Gastric
 3. Intestinal
 - B. Unusable substances are stored, then removed from the body.
 - C. Environmental toxins may be retained by body tissue.
- III. Body fluids distribute essential nutrients and carry wastes away from tissues.
(11 percent)
 - A. The heart and blood vessels are structured to facilitate circulation.
 - B. Blood is the primary circulating body fluid.
 1. Components of blood carry out specific functions.
 - a) Cellular components include erythrocytes, leukocytes and platelets.
 - b) Noncellular components include plasma proteins, inorganic molecules, nutrient and waste molecules.
 - C. Lymph is a secondary circulating body fluid.
 1. Lymph system
 2. Lymph function
 - D. Homeostatic controls maintain cardiac output and blood pressure.
 1. Capillary fluid exchange
 2. Stretch receptors
 3. Metabolic products
- IV. Breathing precedes gas exchange and transport.
(6 percent)
 - A. Mechanics of breathing include inhalation and exhalation.
 - B. Gas exchange occurs between blood and body tissues.
 - C. Blood is necessary for gas transport.

1. Oxygen

2. Carbon dioxide

D. Breathing rate is controlled by respiratory centers in the medulla.

E. Blood oxygen levels affect the rate of red blood cell production.

A. Cellular respiration involves three basic concepts.*

1. Hydrogen and its electron move from weak to progressively stronger electron acceptors.

2. The transfer of hydrogen and its electron releases energy which can be used to form high energy bonds.

3. Energy is stored as ATP.

B. Anaerobic respiration in muscle cells:

1. Takes place in the absence of oxygen.

2. Results in the accumulation of lactic acid.

3. Produces low amounts of ATP.

C. Aerobic respiration:

1. Utilizes oxygen as a final electron acceptor.

2. Requires a cytochrome electron transfer system for the complete oxidation of organic molecules.

3. Results in carbon dioxide and water as end products.

4. Produces high amounts of ATP.

V. Energy is released by the oxidation of organic compounds.

(4 percent)

*These statements are intended as an indicator of the depth in which respiration should be covered.

- D. ATP released during cellular respiration is utilized for several metabolic processes including:
1. Anabolism
 2. Movement and muscle contraction
 3. Heat production
 4. Active transport
- VI. Voluntary movement and body support are the result of skeletal muscles and the skeletons to which they are attached (4 percent)
- A. The skeleton provides for muscle attachment and protection of internal organs.
 - B. Skeletal muscles have a unique structure.
 - C. Muscle contraction is an electrochemical event.
 - D. Muscle contraction requires ATP.
- VII. The kidney provides homeostatic control over body fluids. (8 percent)
- A. The excretory system removes waste products from the blood.
 1. Anatomy of the excretory system including the nephron.
 2. Kidney function and urine formation.
 - B. Body fluid balance is maintained by hormones and ions.
- VIII. Regulation of the internal environment requires coordination between the nervous and hormonal systems. (11 percent--nervous)
- A. Nervous control involves reception, transmission, interpretation and response.
 1. Stimuli in the environment must first be detected by sensory receptors.
 - a) Eye
 - b) Ear
 - c) Chemoreceptors
 - d) Pressure and temperature receptors

2. Neural transmission relays information through an organism.
 - a) Structure of a neuron
 - b) Electrical activity of a nerve impulse
 - c) Chemical transmission between neurons
3. The central nervous system interprets and coordinates.
 - a) Brain regions and spinal cord function
 - b) Autonomic nervous system
- (4 percent--hormonal)
 - B. Endocrine secretions regulate and maintain body functions.
 1. Blood sugar regulation as influenced by insulin, adrenalin and thyroxin.
 2. Hormone levels are regulated by negative feedback as exemplified by thyroxin.
- IX. Humans are capable of reproducing. (8 percent)
 - A. Reproductive systems:
 1. Male
 2. Female
 - B. The development and functioning of the reproductive system is under the control of hormones.
 1. Gonadotropic hormones regulate the production of sex hormones.
 2. Male sex hormones function in developing primary and secondary sex characteristics.
 3. Female sex hormones function in:
 - a) Developing primary and secondary sex characteristics.
 - b) Menstrual cycle and pregnancy control.

C. Fertilization results in:

1. Pregnancy
2. Embryonic and fetal development
3. Parturition



ORGANIZATION FOR INSTRUCTION

Core-Elective Format

The senior high school biology program has been reorganized around two compulsory components: core and elective. Both components are mandatory for instruction. Core is the common program provided to all students throughout the province. This comprises approximately 80 percent of the instructional time. The Program of Studies defines the minimal core program. The elective is a compulsory area but the term elective refers to the specific topic and methodology utilized. This should reflect the teacher's expertise and student's interest in the development of topics covering the related topics for each respective course. Electives comprise approximately 20 percent of the instructional time.

Student Projects

Projects provide an opportunity for students to study biology while developing their investigative skills. The student project should be incorporated as a teaching strategy rather than as a separate unit in the course. This strategy may be utilized throughout the biology courses in either core or elective components. This integrative approach allows students to study a course component individually, in small groups or as a class.

Methodologies will vary considerably and reflect student interests, teacher's expertise, school facilities and school program. Project work should allow students to develop inquiry skills that would help them begin to understand how knowledge is discovered and used.

Safety in School Laboratories

Injuries and accidents in school laboratories can be minimized by:

1. Providing safe school facilities and equipment and limiting class size to numbers which the facility can handle.
2. Teachers becoming familiar with the school safety equipment such as fire extinguishers, fire blankets, showers and eye wash stations.
3. Making students aware of safe procedures in laboratory activities.

Teachers must familiarize themselves with the proper use and maintenance of equipment and handling of chemicals which are available in their school. They must become aware of potential hazards associated with the use of microwave ovens, autoclaves, centrifuges, corrosive chemicals, toxic substances, inflammable materials, volatile liquids, radioactive materials and carcinogens.

Some laboratory investigations require the use of potentially hazardous chemicals. For example, concentrated acids may be required during laboratory investigations or in preparation of necessary solutions. Concentrated acids are frequently corrosive, poisonous irritants, and should be handled carefully. If concentrated acids are placed in dropping bottles for students use, use plastic rather than rubber bulb droppers. Laboratories should contain only those quantities of concentrated acids which would be sufficient for one year's requirements. Iodine stains and solutions are commonly used in laboratory investigations. Prepared iodine solutions should be purchased from the chemical supply houses since crystalline iodine vapor is toxic or extremely irritating and its dust is hazardous when inhaled or touched.

Certain biological investigations require the use of solvents containing ether. Such solvents are highly flammable and extremely explosive. Petroleum ether must be used in lieu of other ethers. (It should be purchased locally as an aerosol from hardware stores or automobile supply houses.)

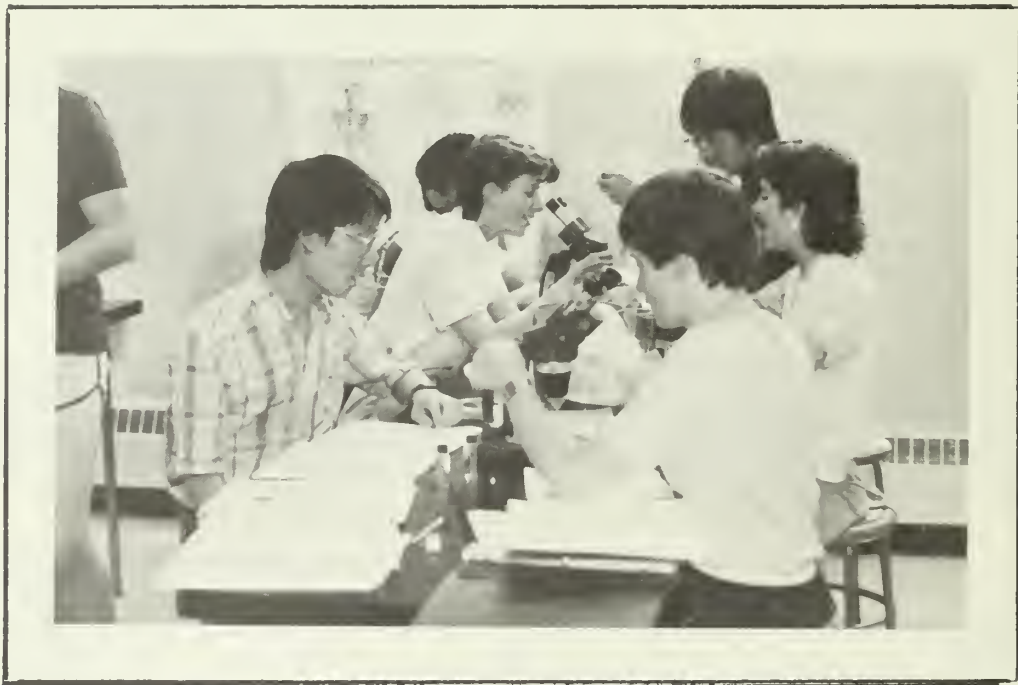
Proper storage facilities must be provided for all potentially dangerous substances. Teachers should refer to the Potentially Hazardous Chemicals Information Guide for the procedure for the storage, use, dangers and disposal of various chemicals. Other safety manuals should be available to teachers and students.

If living organisms are kept in the classroom common sense precautions would keep incidence of allergies and diseases to a minimum. For example, a careful selection must be made of organisms such as nonpathogenic bacteria, healthy plants and animals, nontoxic plants, and molds which are considered safe to handle. Culturing pathogenic organisms in a laboratory voluntarily or by accident must be avoided. For example, some strains of Escherichia coli may cause illness and live outside the culture. Only those strains which cannot live outside nutrient culture media should be used. Contact biological supply houses for safe strains of Escherichia coli. Glassware, incubators and inoculating loops must be kept clean at all times.

Specimens used for dissection or observation must be collected properly, handled carefully, and disposed of without causing infection or contamination. Special care must be taken in collecting and disposing of blood, urine or epidermal cells. Teachers should also be aware of students with special health problems which may restrict their participation in certain laboratory activities.

Basic greenhouse precautions must include such practices as selecting only healthy, "safe" plants which are free of parasites. If an infection does take place and the greenhouse has to be sterilized, extreme care must be taken in selecting a noncarcinogenic herbicide and pesticide.

School boards, along with school administrators, must set up jurisdictional policies relating to accidents and insurance. Teachers must be aware of the implications of these policies.



Historical Aspect

The historical aspect of biology, as dealt with at all levels of the course, is an important part of the background information which makes it possible to understand current and future scientific endeavors.

In Biology 10, for example, the contributions of such scientists as Hooke and Leeuwenhoek are mentioned during discussions of cell theory and the microscope, while Linnaeus must be represented as the individual largely responsible for creating our modern taxonomic system.

The works of Gregor Mendel and Charles Darwin are an integral part of the Biology 20 topics of genetics and speciation.

At the Biology 30 level, reference is made to the research pioneered by scientists including Canadians such as Banting, Best and Penfield which led to understandings and treatments of certain disorders and diseases.

The above-mentioned scientists are just a few of those whose contributions may be discussed in the high school biology courses.



The Gifted Student

Although in certain schools there are special classes or courses for "gifted" students, the teacher of the mainstream biology program deals, on a daily basis, with many students who exhibit characteristics which are commonly attributed to the "gifted." As a curriculum is developed, opportunities must be left open so that the widest possible range of teaching and learning strategies may be employed in order to serve the needs of the gifted student.

One of the major aims in the education of the gifted student is to develop their research, deductive and creative thinking skills. One strategy for fostering these skills would be to provide opportunities for students to plan and carry out independent projects either inside or outside of the classroom or school. Regular programming may have to be compacted to compensate for any time where the student is absent from the regular classroom.

Gifted students may require only minimal staff involvement to carry out independent study programs if they have first been provided with some training in the selection and use of audiovisual equipment for the obtaining of information. Gifted students will require varied amounts of staff involvement to carry out independent study programs. Excessive demands on staff may be decreased if the students are initially trained in the use of audiovisual equipment and appropriate resources are available. Such training would prepare the student to make full use of learning packages, modules, minicourses, etc., which might be introduced either by the student or the teacher, in addition to regular curriculum material.

Resource personnel from the community might be brought into the school for lectures or seminars, or students might be afforded the opportunity to visit or interview personnel who work in their areas of interest. In this "mentor" approach, gifted students might spend time in a work experience type situation outside of the school under the direction of individuals in a specific field of interest.

If economics are a problem, mentors might be employed strictly on a voluntary basis, and might include any interested and capable individuals who could share their expertise. One valuable source of mentors might be university students who are interested in the processes of education. It is essential that all potential mentors actually have sufficient time and interest to assist students in carrying out enrichment projects.

Two approaches may be used to identify topics for study and mentor resources. Firstly, individuals who are interested in becoming mentors may provide lists of possible topics for study in their areas of expertise. Secondly, teachers may approach individuals, who may become mentors, in response to student identified interests and develop a volunteer mentor, or community resources file.

Students can participate in the planning of the file, in locating and interviewing potential mentors, and in listing topic suggestions, as well as making practical suggestions for the utilization of mentor's services.

Gifted students should be encouraged to participate in such activities as science or school fairs. Their involvement would allow students to develop their interests independently and allow them to compare their efforts with their peers. Also, participation at local, provincial and federal levels will expand students' background experience.

Attendance at conferences is another activity students of this calibre should be encouraged to participate in. There often are local conferences which may be an extension of many core topics within the biology curriculum.

For additional suggestions as to strategies which could be employed by the average classroom teacher in dealing with the gifted, many excellent articles are available, such as "Gifted Students, Regular Classroom: 60 Ingredients for a Better Blend," The Elementary School Journal, Volume 82, 1982 or Mentor Assisted Enrichment Projects for the Gifted and Talented by W. A. Gray, Educational Leadership pp. 16-21, November, 1982.

Rationale for Electives

The elective component of the biology program is a compulsory section of the course where students and teachers have some flexibility in determining what is to be studied and how it is to be studied. The topics covered should be related to the respective course taken in that they are based on overall objectives for that program. Elective topics may be discussed periodically throughout the term or dealt with as the opportunity arises.



The use of electives will allow for a greater understanding of the scientific method through the development of laboratory and library research skills. Electives may be pursued utilizing several methods ranging from individual to group studies and from structured to open-ended investigations. Electives should be designed to make science more interesting and meaningful through the assimilation of daily issues and biological knowledge.

The elective section of the biology program should be designed to allow for the extension of student interest and may be approached in several ways:

1. An extension of concepts related to core topics.

This is not meant to be an in-depth study of core material, but rather an opportunity to apply and extend core principles to current issues of student interest. Some examples may be parasitology, contemporary diseases, genetic engineering, nutritional patterns, chemical health hazards, cardiopulmonary resuscitation, influence of the development of the microscope on society, and dichotomous keys.

2. Use of scientific reports, periodicals or journals.

Periodicals present interesting discussions of current issues and demonstrate scientific procedure. These articles convey current research and technological development and allow for extension towards topics relevant to the student's future.

Scientific papers also provide the science student with an opportunity to evaluate scientific procedures ranging from the identification of problems in experimental design to the critical analysis of data. Students may recognize external factors influencing research such as funding, finding qualified personnel, government influence, etc. It should be noted that this approach to elective study will develop an appreciation for the scientist, reinforce an awareness of scientific differences as well as increase scientific literacy.

This approach to elective study allows a teacher latitude to develop an entire unit.

Suggested references could include Canadian Geographic, Discover, Equinox, Nature Canada, Science Digest, Science 83, 84, ..., Science World.

3. A locally developed unit on the environment.

Environmental issues may vary among geographic areas. The choice of issue must be relevant to the biology course and be meaningful to the students.

Examples could include acid rain, land use, winter ecology, urban planning or pond studies.

4. The use of microcomputers.

The microcomputer presents alternate teaching strategies that can provide increased flexibility and scope in dealing with curriculum, either core or electives. The successful implementation of software is primarily dependent upon the suitability of the disk, and the organization of the physical setting.

The pedagogical approaches undertaken by the microcomputer can be listed and explained as follows:

a) Systems Analysis and Simulations

Simulations can provide students with realistic, vicarious experiences of real bio-societal systems. Such simulations allow them to choose different alternatives in such a system. Examples of such use include the simulation of: world food production, the mechanisms of gene mutation, or strategies used for weed and insect control.

Students can use a computer model of a societal system to evaluate data, and become involved in decision making processes. An example can be provided by evaluating the benefits of using insecticide sprays and toxins as a pollutant within the food chain. No alternative presents a panacea. Each alternative is a compromise and the probability of making the most of a human decision.



b) Information Retrieval

Gathered experimental data can be stored and retrieved for later use. Example, air pollution monitoring readings can be stored on disk. SO₂ readings could be compared in different areas and during different seasons or years. Another example could be to pool vegetation plot data on disk for comparisons throughout a number of years. The latter data could become assimilated into a succession study.

- c) The computer can provide an invaluable resource in the statistical manipulation of data. Mathematic modeling of biological phenomena such as illustrated by population growth systems can be organized and presented by graphing techniques, and calculations of population density.

d) Course Review

The microcomputer can provide and organize unit reviews for students in a manner that provides immediate feedback and diagnosis of a student's weaknesses within the area. Most of the course review programs are organized in a drill and practice format, although some other modes do exist. A successful drill and practice style of review should include a tutorial branch for incorrect answers, and thereby incorporate a maximum amount of student interaction.

e) Student Evaluation

Various examination formats can be organized on a disk. An accompanying management system would not only correct the students input but could provide the teacher with class marks and item analysis. This type of evaluation can become a very important ally for students undertaking individualized projects or instruction. The software evaluation programs would allow the students to progress at their own rate and complete the examinations at the appropriate times, while providing teachers with the needed information.

The Computer Technology Branch of Alberta Education is assessing programs for biology, and teachers should be cautioned against purchasing any software without checking with the software clearinghouse for direction.

Guidelines for the Handling of Sensitive Issues

The guidelines for the presentation of potentially sensitive issues should be in accordance with Alberta Education policy re: controversial issues in the classroom (see Appendix A). The intent of the policy statement is to provide for the development of students' capacities to reason logically through divergent and convergent thinking, and to critically examine issues from several, frequently opposing, points of view. Of course, not all points of view can be studied in detail or even presented. However, opposing positions may be expanded upon in order to promote critical thinking as it relates to the interpretation of issues. To encourage such experiences, care should be taken so that neither theories nor beliefs are presented as fact. Because the sensitiveness to an issue would likely vary between and within school districts, and over time, it is unlikely that any list of controversial issues would be complete or relevant to all biology programs. Some issues that serve as examples for teachers to develop with their biology classes would include those that relate to population problems (birth control), acid rain, evolution-creation, nuclear energy uses, genetic manipulation and bioethics.

Identification of particular controversial issues for classroom study should revolve around various criteria as suggested by the following questions:

1. Is the issue appropriate for the target group? Considerations must include cognitive, social, moral and physical development of students as well as their prior background and experience.
2. Is the issue important in society? Issues that are identified for discussion must be important social, economic and political problems facing our society or are seen as being likely future concerns.
3. Will study of the issue contribute to the goals of the program?
4. Can adequate resources about the issue be provided for students, teachers, and other people in the community? Balanced analyses are possible only when the resources fairly and adequately present each major position.
5. Can the issue be appropriately considered within reasonable classroom time in relation to the whole program?
6. Does the presentation reflect professional treatment of the issue in terms of school district policy, the views of the community, and tolerance and understanding of minority viewpoints.

The evolution-creation debate exemplifies one issue which is repeatedly addressed by interest groups. In addressing such an issue, two aspects should be considered. Firstly, that evolution is a scientific theory supported by the scientific community and as a theory is open to modification in light of new scientific evidence and is potentially falsifiable. (e.g. Theory of gravity followed by the theory of relativity.) Secondly, that creationism is a

position held by some religious groups, and is not supported by empirical or scientific facts, and therefore, cannot be presented as such. Frequently, positions based on societal, economic, moral or aesthetic values may be included during the study of an issue. Similarly, the creationist and competing viewpoints might be integrated with the analysis of accepted, scientific theory.

In August, 1972, The Minister of Education announced a policy regarding controversial issues. This announcement was in response to representations having been made regarding the treatment in school programs of such matters as Canadian content, family life education, sex-stereotyping and special creation, to name a few. By way of interpretation the policy is to be treated as a whole: that is, no clause is to be applied in isolation of any other clause or clauses. The policy is intended to accomplish the following in the handling of issues such as those mentioned above.

1. Provincially it will:
 - (a) guide the development and revision of Programs of Study, including the acquisition of support materials.
 - (b) serve as the Department of Education position in cases in which the Department may be consulted regarding controversial issues.
2. Locally, the statement is to serve as a guide for the development of policy at system, district or school levels, according to local choice.

DEPARTMENT OF EDUCATION POLICY Re: Controversial Issues in the Classroom

- I. In principle, it is an objective of the Alberta educational system to develop students' capacities to think clearly, reason logically, examine all issues and reach sound judgments.
- II. The specific policy, based on this principle, is:
 1. Students in Alberta classrooms should not be ridiculed or embarrassed for positions which they hold on any issue, a requirement which calls for sensitivity on the part of teachers, students and other participants in dealing with such issues.
 2. Students should have experiences in selecting and organizing information in order to draw intelligent conclusions from it. For sound judgments to be made, information regarding controversial issues should:
 - (a) represent alternative points of view,
 - (b) appropriately reflect the maturity, capabilities and educational needs of the students and reflect the requirements of the course as stated in the Program of Studies,
 - (c) reflect the neighborhood and community in which the school is located, but not to the exclusion of provincial, national and international contexts.
 3. School trustees should establish, in consultation with appropriate interest groups, policies regarding:
 - (a) identification of controversial issues,
 - (b) treatment of such issues in local classrooms.
 4. Students, teachers and administrative staff should have a voice in determining:
 - (a) the controversial issues to be studied,
 - (b) the texts and other materials to be used,
 - (c) the manner in which such issues are dealt with in the classroom.

In response to representations regarding the treatment of the theory of evolution in school science programs, the Science Curriculum Coordinating Committee prepared and presented the following policy statement to the Curriculum Policies Board. This statement, which interprets the Department's policy regarding controversial issues in relation to science programs in the classroom, was considered by the Curriculum Policies Board in March, 1979, and was accepted by the Minister of Education in June, 1979.

- (a) *That where relevant, official curriculum documents published by Alberta Education for use by science teachers should contain:*
 - (i) *the Department of Education policy statement on controversial issues.*
 - (ii) *a special statement alerting teachers to the need for sensitivity in handling such issues.*
 - (iii) *a listing of available learning resources from which school boards, teachers, and/or students may select items representing alternative points of view on such controversial issues as may be included in a Program of Studies.*
- (b) *That, at the provincial level, all science curriculum committees and/or individuals associated with selecting, recommending, listing and/or prescribing texts and/or other learning resources for use in Alberta schools be directed to:*
 - (i) *confine their choice to those learning resources in which the science subject matter is deemed to be satisfactory in terms of the definition of science:*

Natural Science is a branch of knowledge obtained by the scientific method, which deals with a body of observable and reproducible facts concerning material phenomena, systematically arranged and showing the operation of general laws and theories
 - (ii) *select learning resources that are satisfactory in terms of scientific accuracy, adequacy of treatment, and reading level.*
 - (iii) *recommend the development of such additional materials as may be deemed necessary. (To be used only as a last resort.)*
- (c) *That, in the initial selection stage, the inclusion or exclusion of science subject matter in Alberta school science curricula be determined by validating it according to the definition of 'Natural Science' in (b), (i) above.*

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